Remarks

The present amendment responds to the Official Action dated May 26, 2004. The Official Action rejected claims 1-12, 16, 17, 22 and 26 under 35 U.S.C. § 103(a) based on Crochiere et al. U.S. Patent No. 5,664,011 (Crochiere) in view of Golla et al. U.S. Patent No. 5,724,395 (Golla). The Official Action also rejected claims 13-15 under 35 U.S.C. § 103(a) based on Crochiere and Golla in view of Maulik et al. U.S. Patent No. 6,260,053 (Maulik). The Official Action further rejected claim 18 under 35 U.S.C. § 103(a) based on Crochiere and Golla in view of Walker et al. U.S. Patent No. 5,570,423 (Walker). Claims 19-21 and 23-25 were indicated to be allowable. The foregoing grounds of rejection are addressed below following a brief discussion of the present invention to provide context. Claims 1 and 9 have been amended to be more clear and distinct. Claims 7, 8, 22 and 26 have been cancelled. Claims 1-6, 9-21, and 23-25 are presently pending.

The Present Invention

The present invention provides for canceling echo/near-end-crosstalk in a bi-directional data communications system by partitioning a digital representation of a data signal into first and second portions such that the first portion is processed by a first finite impulse response filter to provide a first filter output value, and a second portion is processed by a second finite impulse response filter to provide a second filter output value. The first finite impulse response filter is configured to filter a first portion of the digital representation of a data signal comprising data, low amplitude echo/near-end-crosstalk components and high amplitude echo/near-end-crosstalk components. The first portion comprises bits representing the low amplitude echo/near-end-crosstalk components of the data signal and least significant bits of the high amplitude echo/near-end-crosstalk components of the data signal. The second finite impulse response filter is coupled to the first finite impulse response filter and is configured to filter a second portion of the digital representation of the data signal, comprising most significant bits of the high amplitude echo/near-end-crosstalk components. The output values from the first and second filters are summed to produce a digital representation of the low and high amplitude echo/near-end-crosstalk components, and the digital representation of the low and high amplitude echo/near-end-crosstalk components is subtracted from the digital representation of the data signal to provide echo/near-end-crosstalk cancellation.

The Rejection of Claims 1-12, 16, 17, 22 and 26

Claims 1-12, 16, 17, 22 and 26 were rejected under 35 U.S.C. § 103(a) based on Crochiere in view of Golla. Applicants respectfully request that this rejection be withdrawn in view of the present amendment and the discussion below.

Claim 1 has been amended to be more clear and distinct. Claim 1 now affirmatively recites that the first finite impulse response filter is configured to filter a first portion of a digital representation of a data signal comprising data, low amplitude echo/near-end-crosstalk components and high amplitude echo/near-end-crosstalk components, the first portion comprising bits representing the low amplitude echo/near-end-crosstalk components of the data signal and least significant bits of the high amplitude echo/near-end-crosstalk components of the data signal. Claim 1 now affirmatively recites that the second finite impulse response filter is configured to filter a second portion of the digital representation of the data signal, comprising most significant bits of the high amplitude echo/near-end-crosstalk components. Claim 9 has also been amended to be more clear and distinct. Claims 7, 8, 22 and 26 have been cancelled, rendering the rejection of such claims moot.

Crochiere discloses an echo canceller having adaptive and non-adaptive filters. Crochiere, col. 3, lines 4-25. Crochiere's filters 126 and 128 are arranged in a cascade with filter 126 in the foreground and filter 128 in the background. The word "cascade" in this context means something that is arranged or occurs in a series or in a succession of stages, so that each stage derives from or acts upon the product of the preceding stage. The filter 126 provides the actual echo cancellation for echo canceller 110 while filter 128 attempts to cancel whatever echo is not canceled by filter 126. Crochiere, col. 5, lines 5-9 and 46-60. The output from adaptive filter 128 is used by the controller 134 to modify the filter coefficients of non-adaptive filter 126. Crochiere, col. 5, lines 10-36. The output from adaptive filter 128 is not used to provide the actual echo cancellation.

By contrast, claim 1 according to the present invention recites that data are partitioned and processed by first and second filters. Such an arrangement is not the cascade arrangement of Crochiere. This was recognized by the Official Action which admits on pages 2 and 3 that "...Crochiere does not mention...means to partition the input data signal such that a portion of the input signal is processed by each FIR filter..." The Official Action further admits at page 2 that "...Crochiere does not mention a second FIR filter in parallel with the first filter, or means to partition the input data signal such that a portion of the input signal is processed by each FIR filter with the filters acting in parallel, or that the filters are, in fact FIR filters". Thus, Crochiere

fails to disclose and fails to suggest the echo/near-end-crosstalk cancellation system of claim 1, which requires two finite impulse response filters configured so that data are partitioned and processed by first and second filters.

Golla discloses a method and architecture for filtering digital signals, that can be implemented using digital filters of the non-recursive linear phase type, also known as finite impulse response (FIR) filters. Golla, col. 1, lines 6-15. Golla provides for splitting the coding of the sampled signal into portions of at least eight bits each, filtering each portion one independently of the other by means of respective digital filters, and then reconstituting the output sampled signal. Golla, col. 2, lines 10-21. For example, Fig. 3 shows an embodiment in which the input signal X(n), sampled at k bits --with k being between eight and sixteen bits-- is split into two portions XM(n) and XL(n) of eight bits each. These signal portions respectively represent the most significant and least significant parts of the digital coding that constitutes the input signal. Each portion, XM(n) and XL(n) of the input signal is applied directly to the inputs A0, . . . , A7 of corresponding programmable filters. The outputs of such filters are summed together at block 5 to reconstitute the output signal Y(n). Golla, col. 4, lines 49-58.

Golla fails to disclose and fails to suggest the system defined in claim 1. Golla further fails to disclose and fails to suggest a system including two finite impulse response filters configured as defined in claim 1. For example, Golla fails to disclose and fails to suggest a first finite impulse response filter configured to filter a first portion of a digital representation of a data signal comprising data, low amplitude echo/near-end-crosstalk components and high amplitude echo/near-end-crosstalk components, the first portion comprising bits representing the low amplitude echo/near-end-crosstalk components of the data signal and least significant bits of the high amplitude echo/near-end-crosstalk components of the data signal. Golla also fails to disclose and fails to suggest a second finite impulse response filter coupled to the first finite impulse response filter, the second finite impulse response filter configured to filter a second portion of the digital representation of the data signal, the second portion comprising most significant bits of the high amplitude echo/near-end-crosstalk components. Instead, Golla splits a signal so that the eight most significant bits are filtered by a first filter. Golla, Figs. 1 and 2; col. 3, lines 17-19; col. 4, lines 52-55. Golla then directs the remaining least significant bits to a second filter. Golla, col. 3, lines 25-28. Golla further generates and adds missing bits as needed to make up a full 8 bits which are input to the second filter. Golla, Fig. 2 and col. 3, lines 25-31.

In addition, Golla fails to disclose and fails to suggest the application of Golla's method, or the inclusion in Golla's architecture, of a data partitioning means for partitioning a data signal having echo/near-end-crosstalk components such that a first portion of a partitioned data signal is processed by such a first finite impulse response filter to provide a first filter output value, and

such that a second portion of the partitioned data signal is processed by such a second finite impulse response filter to provide a second filter output value. In this regard, Golla identifies the filters to be used as being "programmable digital filters" ("PFP filters"). Golla, col. 2, lines 40-50. PFP filters are further identified in just now discovered Golla et al. U.S. Patent No. 5,594,677 (" '677 patent") which itself makes reference to Cavallotti et al. U.S. Patent No. 5,053,984 ("Cavallotti"), copies of which are enclosed. PFP filters are FIR filters. Nevertheless, the applicability of PFP filters to the echo/near-end crosstalk filtration of the present invention has not been established by the Office Action. There are a large number of types of FIR filters, and it is the function of the filter, not that a filter is employed, that is the relevant consideration. There has been no showing that the filters of Golla perform the same function as do Applicants' filters.

Furthermore, one of ordinary skill in the art would not combine the teachings of Crochiere and Golla. Golla's finite impulse response filters are configured to output a filtered, desired signal. Crochiere's filters are configured to output echo signals from which the desired signal is absent. For example, the output of adaptive filter 30 in Crochiere Fig. 1, and the outputs of adaptive filter 128 and non-adaptive filter 126 in Crochiere Fig. 2, are replicas of the echo signal. They are subtracted by the subtracters 32, 132 and 130, respectively, from the signals generated at the microphones 28 and 120. Crochiere, col. 3, line 66 - col. 4, line 3; and col. 5, lines 46-60. The outputs of the filter circuits shown in Golla Figs. 1-4 to the contrary constitute filtered, desired signals. Golla, col. 2, lines 10-14; col. 3, lines 31-33; col. 4, lines 6-33; col. 4, lines 49-58; and col. 5, lines 12-24. Therefore, applicants respectfully object to the suggested combination of Crochiere and Golla as contrary to the teachings of these references.

For the foregoing reasons, Crochiere and Golla, taken alone or in combination, fail to disclose and fail to suggest an echo/near-end-crosstalk cancellation system for a bi-directional data communications system as defined in exemplary claim 1. Since claims 2-6, 9-12, 16 and 17 depend from an allowable independent claim they too are allowable over the cited references.

The Rejection of Claims 13-15

Claims 13-15 were rejected under 35 U.S.C. § 103(a) based on Crochiere and Golla further in view of Maulik. Applicants respectfully request that this rejection be withdrawn in view of the discussion below.

Maulik discloses a scalable finite impulse response filter having at least one linear phase decimation-by-two processing element. Maulik, col. 1, lines 46-48. Maulik is cited by the Official Action at page 6 solely for its disclosure regarding direct and transpose form finite

impulse response filters. The discussion above with regard to Crochiere and Golla is repeated here and is dispositive, and the discussion of Maulik is moot.

The Rejection of Claim 18

Claim 18 was rejected under 35 U.S.C. § 103(a) based on Crochiere and Golla further in view of Walker. Applicants respectfully request that this rejection be withdrawn in view of the discussion below.

Walker discloses a method of providing adaptive echo cancellation in a transmission system having an echo canceller with a finite impulse response filter. Walker, col. 2, lines 43-45. Walker is cited by the Official Action at page 6 solely for its disclosure regarding floating and fixed-point numbers. The discussion above with regard to Crochiere and Golla is repeated here and is dispositive, and the discussion of Walker is moot.

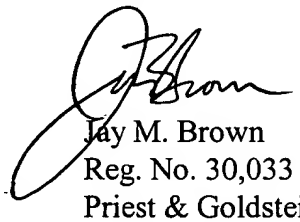
Allowable Subject Matter

Applicants acknowledge with appreciation the indication that claims 19-21 and 23-25 are allowable.

Conclusion

All of the presently pending claims, as amended, appearing to define over the applied references, withdrawal of the present rejection and prompt allowance are requested.

Respectfully submitted,



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